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BULLETIN No. 188

METHODS OF FERTILIZING SWEET POTATOES

By C. E. DURST

URBANA, ILLINOIS, APRIL, 1916

Summary of Bulletin No. 188

1. Fertilizer experiments were conducted with sweet potatoes at Anna, in Union county, for five years. Page 269

2. Three plats were fertilized under the ridge with a complete home-mixed fertilizer, steamed bone, and manure, respectively, while three others received the same fertilizers broadcast. Two additional plats were left untreated as checks. Page 269

3. The potatoes were graded into "table" and "seed" potatoes, and "strings," in accordance with the standards used in that section. Page 270

4. As the price of sweet potatoes varies somewhat, according to the time of year they are sold, the returns were estimated on the basis of two sets of prices. Page 271

5. Altho all the fertilized plats produced higher average yields than the untreated plats, only manure or steamed bone applied under the ridge gave sufficiently increased yields to return any material profit as compared with the check plats, after deducting the cost of the fertilizer and neglecting the residues. Page 276

6. All of the fertilizer treatments supplied more of the elements for which they were used than was removed by the sweet-potato crops. Page 277

7. Manure under the ridge gave higher net returns than any other treatment, and in addition, supplied a greater excess of fertility over that removed in the sweet potatoes than any treatment except manure broadcast. The manure also supplied a considerable quantity of organic matter. Pages 276, 277

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METHODS OF FERTILIZING SWEET POTATOES

By C. E. DURST, Associate in Olericulture

The method of application of fertilizers has an important influence on the yield in the case of a number of vegetable crops. In order to secure data on certain phases of this question in relation to the sweet potato, tests were begun by the Station in 1910 and were continued for five years. The tests were conducted at Anna, in Union county, which is in the leading commercial sweet-potato section of Illinois.

METHOD OF CONDUCTING THE TESTS

The land used in this experiment was of the unglaciated yellow silt loam common to the extreme southern part of Illinois. The tract used had a slight slope to the north and was perhaps as uniform in all respects as it is possible to obtain in that section. Eight plats were laid out, each 66 feet by 20 feet. Thus, each plat consisted of exactly 1/33 of an acre. The treatments of the various plats each year were as follows:

Plat 1. Check
Plat 2. Twenty pounds home-mixed fertilizer broadcast
Plat 3. 640 pounds manure broadcast
Plat 4. Sixteen pounds steamed bone broadcast
Plat 5. Check
Plat 6. Twenty pounds home-mixed fertilizer under ridge
Plat 7. 640 pounds manure under ridge
Plat 8. Sixteen pounds steamed bone under ridge

The home-mixed fertilizer applied to Plats 2 and 6 consisted of two parts steamed bone, two parts dried blood, and one part potassium sulfate, by weight. Since each plat consisted of 1/33 of an acre, the rates of application per acre were 660 pounds home-mixed fertilizer, 10.56 tons manure, and 528 pounds steamed bone, respectively.

The manure applied broadcast to Plat 3 was applied in some years before plowing and in other years after plowing. When applied after plowing, it was thoroly mixed with the soil by disking and harrowing. The home-mixed fertilizer and the steamed bone applied broadcast were in all cases applied after plowing and disking, and were mixed with the soil by harrowing before the ridges for planting the sweet potatoes were made. For applying the fertilizers and manure under the ridges in Plats 6, 7, and 8, the land was plowed, disked, and harrowed the same as for the other plats. Then a furrow was made where each row of sweet potatoes was to be planted. The fertilizer or manure was scattered in the furrow, after which a ridge was made directly over it, with the tools usually employed in preparing ridges for the

planting of sweet potatoes. Six ridges, for planting as many rows, were made lengthwise of each plat. Thus the rows were 3⅓ feet apart.

The sweet-potato plants, which had been grown in hotbeds, were planted by means of a spade, as is customary in the locality in which these experiments were conducted. The plants were placed approximately sixteen inches apart in the row. They were cared for in the usual manner, all plats being treated alike as to tillage and incidental care. Each year the crop was allowed to grow as late in the season as seemed reasonably safe, the harvesting dates varying from October 11 to 21.

METHOD OF GRADING THE CROP

As soon as dug, the sweet potatoes were separated into three grades, according to the method used by commercial growers in the locality. All potatoes having a diameter of 1½ inches or more, unless badly distorted, were classified as "table" potatoes. In the next grade, designated as "seed" potatoes, shape as well as size was considered. All comparatively short, smooth potatoes of fairly good size (i.e., from about 1 to 1½ inches in diameter) were included in this grade. Any specimens showing a tendency toward lengthiness were discarded. All potatoes too deficient in size or shape to be included in either of the above grades were designated as "strings." On account of the rigid selection, on the basis of shape, for the seed grade, some potatoes of fairly good size were included in the "strings."

RESULTS OF THE TESTS

The yields of sweet potatoes from the various plats each year, graded into table potatoes, seed potatoes, and "strings," are given in Table 1. The figures used in this table indicate pounds per plat, the weights being taken in the field at digging time. For fertilizer treatment of the different plats, see page 269.

The percentages of the crop graded as table potatoes and as "strings" from each plat each year are given in Table 2. The figures for 1913 are omitted in this and following tables because of unaccountable discrepancies in the checks. The averages for the four years from each plat are also given. These averages have been calculated from the total product from a given plat for the four years, rather than from the percentages for each year.

The yields of table and seed potatoes from the various plats, calculated to terms of bushels per acre, are given in Table 3. In making these calculations, it has been assumed that 55 pounds of sweet potatoes are equivalent to one bushel.

Obviously the value of a fertilizer treatment is determined largely by the prices received for the products. As the price of sweet potatoes varies from season to season and according to the time of year they

are marketed, the figures in Tables 4 and 5 have been calculated on the basis of two sets of prices. A common price in southern Illinois at digging time in October is 50 cents per bushel for the table grade and 25 cents per bushel for the seed grade. The values in Table 4 were calculated on the basis of these prices.

If the crop is stored for a time, better prices may usually be secured, tho they are quite variable from season to season. Between Thanksgiving and February 1, when the bulk of the stored table potatoes is usually sold, the prices range between 50 cents and $1 per bushel, as a rule; occasionally, a higher point than the latter figure is reached. The seed grade is ordinarily sold in April, when the price is about $1 per bushel. The demand for this grade is not great, however, owing to the fact that many growers save their own seed. Considering all the circumstances, it is believed that 75 cents per bushel for both grades represents a fair price for stored potatoes. Table 5 presents the values calculated on this basis.

The "strings" were not considered in Tables 4 and 5 in determining the value of the crop, since this grade usually is not sold but is left on the ground or fed to stock.

In both Tables 4 and 5, the value per acre of the crop from each plat is given in the column headed "Gross," under each year. In the column headed "Net," under each year, is given the value of the crop from each plat, minus the cost of the fertilizer applied to the given plat. The cost of the fertilizers is based upon the following prices per ton for the various materials: steamed bone, $25; dried blood, $45; potassium sulfate, $50; manure, $1.50. These prices prevailed during the time the experiments were conducted. This would make the cost per acre for the different treatments as follows: Plats 2 and 6, $12.54; Plats 3 and 7, $15.84; Plats 4 and 8, $6.60.

In Table 6 is given the total number of bushels of sweet potatoes produced per acre under each treatment for the four years combined; the amounts of fertilizing elements furnished during that time by the various treatments; the quantities of each element removed from the soil by the potatoes; and the excess supplied by the fertilizers over the amounts contained in the crops. The fertility content of the sweet potatoes is based upon the figures presented in Circular 182 (page 5) of this Station. The amounts of the fertilizing elements supplied by the treatments are based upon the following figures:

Dried blood, 14 percent nitrogen
Steamed bone, 12½ percent phosphorus
Sulfate of potash, 42½ percent potash
Manure, 10 pounds nitrogen, 3 pounds phosphorus, and 8 pounds potash per ton[1]

No allowance has been made for the small amount of nitrogen contained in steamed bone. The "strings" were not considered, since they were left on the ground and their fertility content was thus returned to the soil.

[1]Horse manure, shipped from St. Louis, Missouri, was used in these experiments.

TABLE 1.—YIELDS OF SWEET POTATOES FOR FIVE YEARS IN FERTILIZER EXPERIMENT AT ANNA

(Expressed in pounds per plat)

Plat	1910			1911			1912			1913			1914		
	Table	Seed	Strings	Table	Seed	Strings	Table	Seed	Strings	Table	Seed	Strings	Table	Seed	Strings
1	111.5	46.8	91.9	179.50	81.25	65.25	107.5	40.5	36.0	58.5	31.0	30.5	108.6	65.9	44.7
2	122.8	47.0	71.8	215.75	83.75	74.50	123.5	37.6	42.2	103.3	33.2	38.4	165.7	53.8	36.5
3	157.0	51.0	94.6	250.75	92.25	77.25	122.3	32.1	39.2	166.3	41.5	33.1	179.4	50.1	33.6
4	124.4	69.9	75.4	156.25	74.00	78.25	106.5	29.9	36.2	120.9	23.5	37.7	210.0	49.6	22.7
5	102.7	41.7	92.1	191.75	75.00	77.50	116.9	36.5	33.5	155.4	46.7	46.0	128.4	47.0	64.7
6	133.8	44.8	115.8	239.25	61.25	73.00	131.8	14.1	55.7	144.5	29.2	30.4	183.7	74.0	56.2
7	161.2	37.0	90.5	326.25	50.25	95.25	147.4	26.3	51.8	125.2	37.3	23.4	238.0	74.1	15.4
8	128.3	43.7	55.7	252.00	78.25	89.25	109.9	24.0	45.3	145.3	52.5	32.7	181.7	76.6	44.1

TABLE 2.—PERCENTAGE OF SWEET POTATOES OF TABLE GRADE AND PERCENTAGE OF "STRINGS" (CULLS)

(Based on weights)

Plat	Treatment	1910		1911		1912		1914		Average	
		Table	Strings	Table	Strings	Table	Strings	Table	Strings	Table	Strings
1	Check	44.56	36.73	55.06	20.02	58.42	19.57	49.54	20.39	51.78	24.29
2	Home-mixed fertilizer broadcast	50.83	29.72	57.67	19.92	60.75	20.76	64.73	14.26	58.40	20.93
3	Manure broadcast	51.88	31.22	59.67	18.38	63.17	20.25	68.19	12.77	60.15	20.74
4	Steamed bone broadcast	46.12	27.96	50.65	25.36	61.70	20.97	74.39	8.04	57.80	20.57
5	Check	43.42	34.71	55.70	22.51	62.55	17.92	53.48	26.95	53.56	26.57
6	Home-mixed fertilizer under ridge	45.45	39.33	64.06	19.54	65.37	27.62	58.52	17.90	58.18	25.41
7	Manure under ridge	55.84	31.21	69.16	20.19	65.38	27.63	72.67	4.70	66.45	19.26
8	Steamed bone under ridge	56.35	24.46	60.07	21.28	61.33	25.28	60.09	14.58	59.52	20.76

TABLE 3.—YIELDS OF TABLE AND SEED SWEET POTATOES

(Expressed in bushels per acre)

Plat	Treatment	1910		1911		1912		1914		Average	
		Table	Seed	Table	Seed	Table	Seed	Table	Seed	Table	Seed
1	Check	66.90	28.08	107.70	48.75	64.50	24.30	65.16	39.54	76.07	35.17
2	Home-mixed fertilizer broadcast	73.68	28.20	129.45	50.25	74.10	22.56	99.42	32.28	94.16	33.32
3	Manure broadcast	94.20	30.60	150.45	55.35	73.38	19.26	107.64	30.06	106.42	33.82
4	Steamed bone broadcast	74.64	41.94	93.75	44.40	63.90	17.94	126.00	29.76	89.57	33.51
5	Check	61.62	25.02	115.05	45.00	70.14	21.90	77.04	28.20	80.96	30.03
6	Home-mixed fertilizer under ridge	80.28	26.88	143.55	36.75	79.08	8.46	110.22	44.40	103.28	29.12
7	Manure under ridge	96.72	22.20	195.75	30.15	88.44	15.78	142.80	44.46	130.92	28.15
8	Steamed bone under ridge	76.98	26.22	151.20	46.95	65.94	14.40	109.02	45.96	100.79	33.38

TABLE 4.—VALUE PER ACRE OF TABLE AND SWEET POTATOES COMBINED, AT 50 AND 25 CENTS PER BUSHEL, RESPECTIVELY

Plat	Treatment	1910		1911		1912		1914		Average	
		Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net
1	Check	$40.47	$40.47	$66.04	$66.04	$38.33	$38.33	$42.47	$42.47	$46.83	$46.83
2	Home-mixed fertilizer broadcast	43.89	31.35	77.29	64.75	42.69	30.15	57.78	45.24	55.41	42.87
3	Manure broadcast	54.75	38.91	89.07	73.23	41.51	25.67	61.34	45.50	61.67	45.83
4	Steamed bone broadcast	47.81	41.21	57.98	51.38	36.44	29.84	70.44	63.84	53.17	46.57
5	Check	37.07	37.07	68.78	68.78	40.55	40.55	45.57	45.57	47.99	47.99
6	Home-mixed fertilizer under ridge	46.86	34.32	80.97	68.43	41.66	29.12	66.21	53.67	58.93	46.38
7	Manure under ridge	53.91	38.07	105.42	89.58	48.17	32.33	82.52	66.68	72.51	56.67
8	Steamed bone under ridge	45.05	38.45	87.34	80.74	36.57	29.97	66.00	59.40	58.74	52.14
	Average of the two check plats	....	38.77	....	67.41	....	39.44	....	44.02	....	57.41

TABLE 5.—GROSS AND NET[1] VALUE PER ACRE OF BOTH TABLE AND SEED POTATOES AT 75 CENTS PER BUSHEL

Plat	Treatment	1910		1911		1912		1914		Average	
		Gross	Net	Gross	Net	Gross	Net	Gross	Net	Gross	Net
1	Check	$71.23	$71.23	$117.34	$117.34	$66.60	$66.60	$78.53	$78.53	$83.43	$83.43
2	Home-mixed fertilizer broadcast	76.41	63.87	134.78	122.24	72.50	59.96	98.78	86.24	95.62	83.08
3	Manure broadcast	93.60	77.76	154.35	138.51	69.48	53.64	103.28	87.44	105.18	89.34
4	Steamed bone broadcast	87.44	80.84	103.61	97.01	61.38	54.78	116.82	110.22	92.31	85.71
5	Check	64.98	64.98	120.04	120.04	69.03	69.03	78.93	78.93	83.25	83.25
6	Home-mixed fertilizer under ridge	80.37	67.83	135.23	122.69	65.66	53.12	115.97	103.43	99.31	86.77
7	Manure under ridge	89.19	73.35	169.43	153.59	78.17	62.33	140.45	124.61	119.31	103.47
8	Steamed bone under ridge	77.40	70.80	148.61	142.01	60.26	53.66	116.24	109.64	100.63	94.03
	Average of the two check plats	....	68.11	....	118.69	....	67.82	....	78.73	.....	83.34

[1]Amount above cost of fertilizers.

TABLE 6.—FERTILIZING ELEMENTS SUPPLIED BY FERTILIZERS AND AMOUNTS REMOVED BY TABLE AND SEED POTATOES DURING FOUR YEARS: ACRE BASIS

Plat	Treatment	Total table and seed potatoes produced	Supplied by fertilizers			Removed by sweet potatoes			Excess supplied over amounts used by crops		
			Nitrogen	Phosphorus	Potash	Nitrogen	Phosphorus	Potash	Nitrogen	Phosphorus	Potash
		bu.	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*	*lbs.*
1	Check	444.93	....	....	....	53.4	7.9	68.3	....	....	.....
2	Home-mixed fertilizer broadcast	509.94	147.8	132.0	224.4	61.2	8.9	78.3	86.6	123.1	146.1
3	Manure broadcast	560.94	422.4	126.7	337.9	67.3	9.8	86.1	355.1	116.9	251.8
4	Steamed bone broadcast	492.33	....	264.0	....	59.1	8.6	75.6	.....	255.4	.....
5	Check	443.97	....	....	....	53.3	7.8	68.2	.....	.....	.....
6	Home-mixed fertilizer under ridge	529.62	147.8	132.0	224.4	63.6	9.3	81.3	84.2	122.7	143.1
7	Manure under ridge	636.30	422.4	126.7	337.9	76.4	11.1	97.7	346.0	115.6	240.2
8	Steamed bone under ridge	536.67	....	264.0	....	64.4	9.4	82.4	.....	254.6	.....

DISCUSSION OF THE RESULTS

An examination of the figures in Table 2 shows that in two years of the four (1910 and 1914) both check plats gave lower percentages of table potatoes than any of the fertilized plats. In 1911, only Plat 4, receiving steamed bone broadcast, yielded a lower percentage than either check plat. In 1912, Plats 4 and 8, receiving steamed bone broadcast and under the ridge, respectively, gave slightly lower percentages than Plat 5, but higher than Plat 1, the other check. The four-year averages show that the percentage of table potatoes was higher for each of the fertilized plats than for either check plat.

Table 2 shows further that in two years of the four, Plat 6, receiving home-mixed fertilizer under the ridge, gave a higher percentage of table potatoes than the corresponding plat fertilized broadcast (Plat 2), and that the reverse was true the other two years. Plat 7, receiving manure under the ridge, yielded a higher percentage of table potatoes every year of the four than Plat 3, which received manure broadcast. In two years of the four, Plat 8, receiving steamed bone under the ridge, gave a higher percentage of table potatoes than Plat 4, fertilized with steamed bone broadcast; in a third year, the percentages were practically equal. The four-year averages favor the application of fertilizer under the ridge except in the case of the home-mixed fertilizer. The highest percentage of table potatoes and the lowest percentage of "strings" for the four years as a whole were secured from Plat 7, fertilized with manure under the ridge.

The figures in Table 3 show that all the fertilized plants gave markedly better average yields of table potatoes than either of the check plats. In 1910 and 1914, both check plats yielded fewer bushels of table potatoes than any of the fertilized plats; in 1911 there was only one exception (Plat 4); and in 1912 there were two (Plats 4 and 8). The highest yield of table potatoes was secured every one of the four years from Plat 7, fertilized with manure under the ridge, and this plat was distinctly superior to all others in average yield of table potatoes for the four years. The second highest average yield was from Plat 3, which was manured broadcast.

In comparing the results from fertilizing under the ridge with those from fertilizing broadcast (Table 3), it is seen that in every year of the four, the home-mixed fertilizer produced a larger yield of table potatoes when applied under the ridge than when applied broadcast: in every year of the four, the manure under the ridge produced a larger yield than the manure broadcast; and the steamed bone gave better results under the ridge three years of the four. The four-year average was, in the case of each fertilizer, distinctly in favor of the plat in which the material was applied under the ridge.

While favorable results followed the use of the fertilizers in nearly all cases, the figures in Tables 4 and 5 show that one must take into

account the prices likely to be received for the potatoes when considering the advisability of using any of these treatments.

At 50 cents per bushel for the table potatoes and 25 cents for the seed grade (Table 4), there was a general increase in the net value of the crop in only two years of the four. In three years of the four, home-mixed fertilizer broadcast gave lower net returns than the average of the check plats. The same fertilizer applied under the ridge gave better net returns than the average of the check plats in only two years of the four, the four-year averages being about equal. Manure broadcast gave practically the same net returns as the average of the checks two years of the four; in one it gave a net return of about $6 higher; and in the fourth it gave about $14 lower. The four-year averages show a lower net return from manure broadcast than from either of the check plats. Manure under the ridge gave higher net returns than the check average two years of the four; in another the results were practically the same; and in the fourth manure under the ridge gave a net return of about $7 lower than the check average. Steamed bone under the ridge gave better net returns than the check average two years of the four; in another the returns were practically equal; and in the fourth there was a deficiency of about $10 for steamed bone under the ridge. The four-year net return from steamed bone under the ridge was about $5 higher than the check average. The four-year averages, as a whole, show that only in Plats 7 and 8, fertilized under the ridge with manure and steamed bone, respectively, were the increases in yield sufficient to give any material profit as compared with the check plats, after deducting the cost of the fertilizers.

At 75 cents per bushel for both table and seed potatoes (Table 5), the results were somewhat more favorable as a whole toward the fertilizer treatments. Home-mixed fertilizer broadcast gave better net returns than either of the check plats in only two years of the four, the four-year averages being about equal. The same fertilizer applied under the ridge gave higher net returns than the check average two years of the four, and in one other they were practically equal. The four-year net-return averages favor the home-mixed fertilizer under the ridge over no treatment by only about $3 per acre. Manure broadcast exceeded the check average in net returns three years of the four, the four-year net returns being exactly $6 in favor of the manure. Manure under the ridge gave higher net returns than the check average three years of the four, and in the fourth the decrease amounted to only about $5 per acre. The four-year net returns favor manure under the ridge over no treatment by about $20 per acre. Steamed bone broadcast gave higher net returns than the check average in only two of the four years, and lower returns in the other two, tho the superiority in the first case exceeded the inferiority in the second. The four-year averages favor steamed bone under the ridge over no treatment by about $11 per acre. As with the prices used in

calculating Table 4, only manure and steamed bone applied under the ridge gave sufficiently increased yields to cause any material profit as compared with the check plats, after deducting the cost of the fertilizers.

In considering the advisability of using any of the above treatments one should bear in mind two additional factors. No allowance has been made for the labor of applying the fertilizers, which would be an important item in the case of application under the ridges. On the other hand, the fertility supplied by the fertilizer treatments during the four years was not all consumed by the sweet-potato crops. Table 6 shows that all of the treatments furnished more of the elements for which the fertilizers were used than was removed by the crops. Manure under the ridge (Plat 7) not only produced larger yields and greater net returns (Tables 4 and 5) than any of the other treatments, but left more fertility in the soil, as a whole, than any treatment, except that given Plat 3, which ranked only slightly higher. The manure applied to Plats 3 and 7 furnished a considerable amount of organic matter in addition to the fertilizing elements, something which cannot be said of any of the other treatments. The manure treatments (Plats 3 and 7) each left about 265 pounds more of the element nitrogen in the soil per acre during the four years than the home-mixed fertilizer treatments (Plats 2 and 6), slightly more phosphorus, and about 100 pounds more potash. The steamed bone (Plats 4 and 8) left about 130 pounds more of phosphorus in the soil than the manure. It should be borne in mind that the nitrogen is subject to loss by drainage and oxidation and that only part of the excess of this element, therefore, would be available for future crops. Phosphorus and potash are not lost from the soil to any appreciable extent thru these causes, hence practically all of the excess of these elements supplied could be used by succeeding crops.

CONCLUSIONS

1. Under the conditions of these experiments, each of the fertilizer treatments described is capable of increasing the percentage of table potatoes produced. With the possible exception of the home-mixed fertilizer, higher percentages of table potatoes are produced when the fertilizer is applied under the ridge than when broadcasted.

2. Each of the fertilizer treatments increases the yields as well as the percentages of table potatoes. Higher yields are secured when the fertilizer is applied under the ridge than when applied broadcast.

3. The prices likely to be received for the crop should be taken into account when considering the advisability of employing any of these treatments.

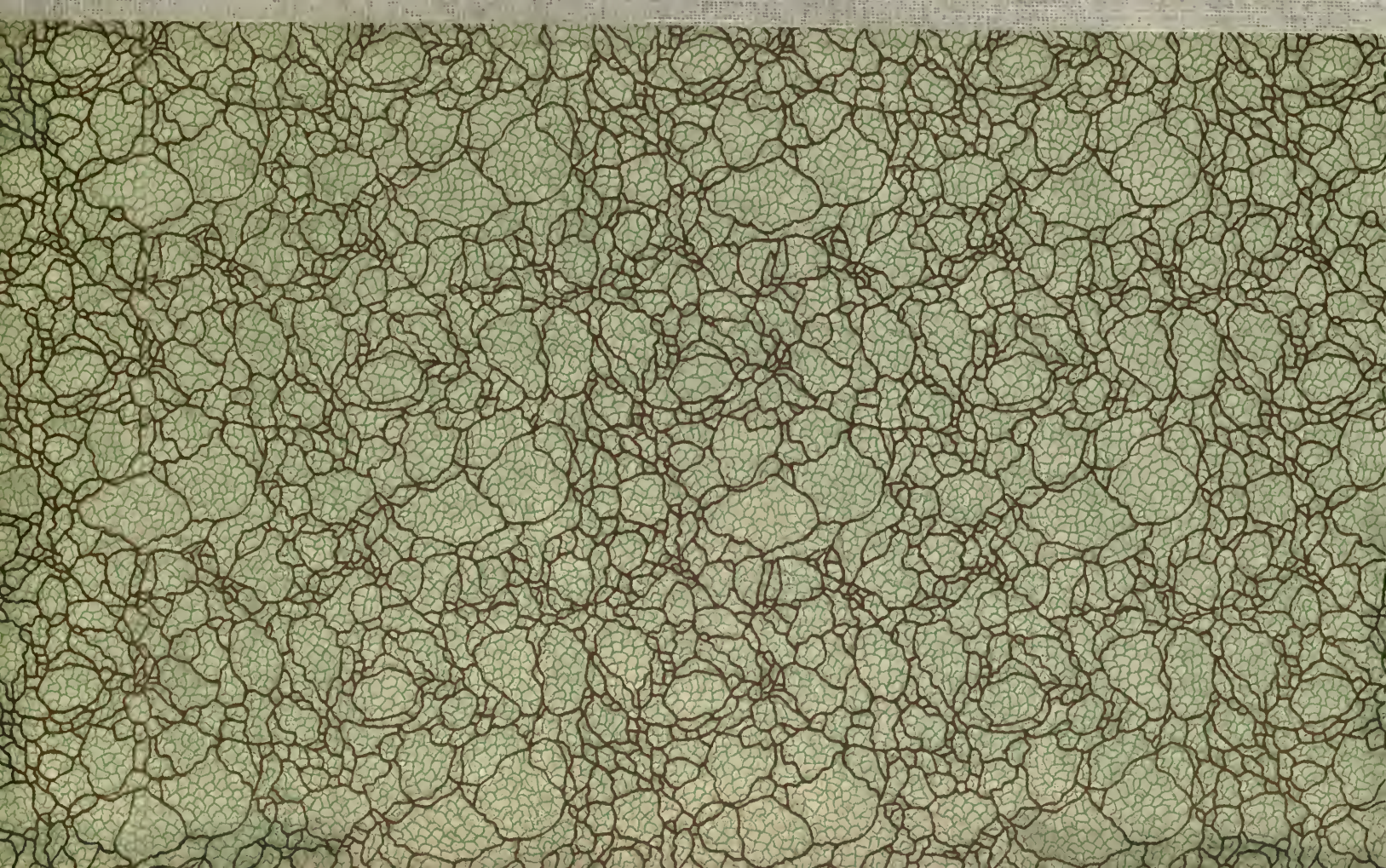
4. Only manure or steamed bone applied under the ridge is likely to give a material increase in the net value of the crop, after deducting the cost of the fertilizer.

5. As is generally the case, the results are somewhat more favorable toward the use of the fertilizers when the prices received for the potatoes are high than when they are low.

6. It is a significant fact that a relatively small proportion of the elements supplied by the fertilizers is removed by the sweet potatoes, and that a large part of the fertility remains, therefore, for subsequent crops.

7. Manure applied under the ridge not only results in the highest net returns, but leaves more fertilizer value in the soil than any other treatment except manure broadcast. This exception is explained by the fact that manure broadcast, while it supplies the same amount of fertility as manure under the ridge, gives a lower yield of potatoes. The manure also adds considerable organic matter to the soil, which cannot be said of any other treatment.

SECTIONAL VIEW OF EXPERIMENTAL PLATS AT ANNA, 1911



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